

Table S1 The ICP-OES and XPS data for catalysts.

Catalysts	MnCo ₂ O ₄	p-MCO@MnS-5
ICP-Molar ratio (Mn:Co)	0.4:1	0.5:1
XPS-Molar ratio (Mn:Co:O)	0.5:1:2.5	
XPS-Molar ratio (Mn:Co:O:S)		0.6:1:3.1:0.2

Table S2 Electrochemical data (MnCo₂O₄, MCO@MS-1, MCO@MS-3, MCO@MS-5, MCO@MS-10) from three independently synthesized electrodes and their corresponding standard deviation (SD).

	MnCo ₂ O ₄	MCO@MS-1	MCO@MS-3	MCO@MS-5	MCO@MS-10
η_{10} (mV)	440±1.6	380±2.4	365±1.8	335±1.2	392±2.1
Tafel (mV dec ⁻¹)	149.3±0.7	138.4±0.3	131.6±0.2	128.6±0.4	140.8±0.3
Cdl (F cm ⁻²)	0.027±0.002	0.105±0.003	0.126±0.008	0.175±0.007	0.072±0.001
Rct (Ω)	19.2±0.41	7.8±0.12	6.2±0.53	4.7±0.21	14.2±0.12

Table S3 Electrochemical data (p10-MCO@MS-5, p20-MCO@MS-5, p30-MCO@MS-5) from three independently synthesized electrodes and their corresponding standard deviation (SD).

	p10-MCO@MS-5	p20-MCO@MS-5	p30-MCO@MS-5
η_{10} (mV)	310±1.4	290±1.7	320±0.9
Tafel (mV dec ⁻¹)	114±0.5	124.5±0.3	103.1±0.9
Cdl (F cm ⁻²)	0.166±0.003	0.194±0.005	0.156±0.002
Rct (Ω)	4.5±0.23	2.2±0.34	2.7±0.12

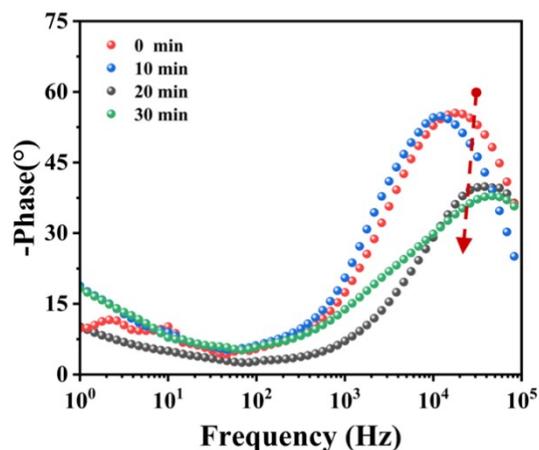


Figure S1 bode spectra of p-MCO@MS samples with different OER times

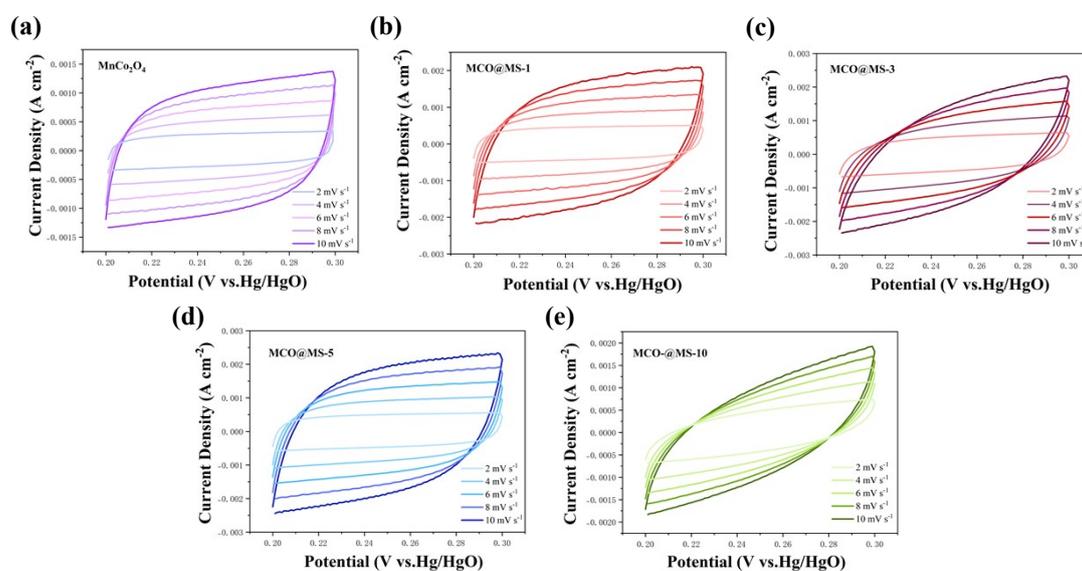


Figure S2 Cyclic voltammetry curves of different MCO@MS-x samples at various scan rates (2, 4, 6, 8, 10 mV s^{-1}).

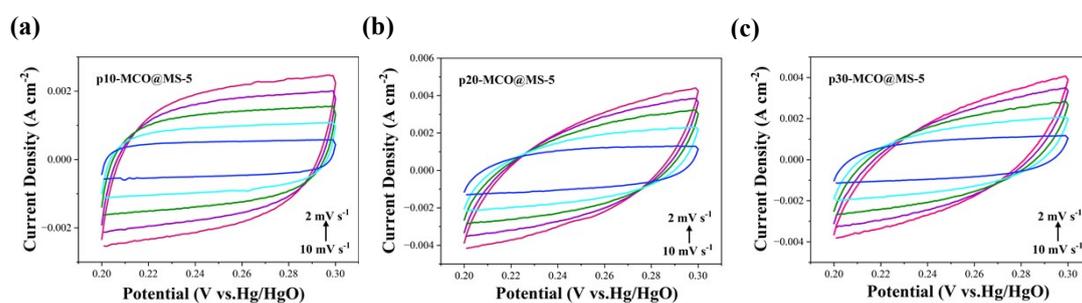


Figure S3 Cyclic voltammetry curves of p-MCO@MS-5 samples with different plasma etching times at various scan rates (2, 4, 6, 8, 10 mV s^{-1}).

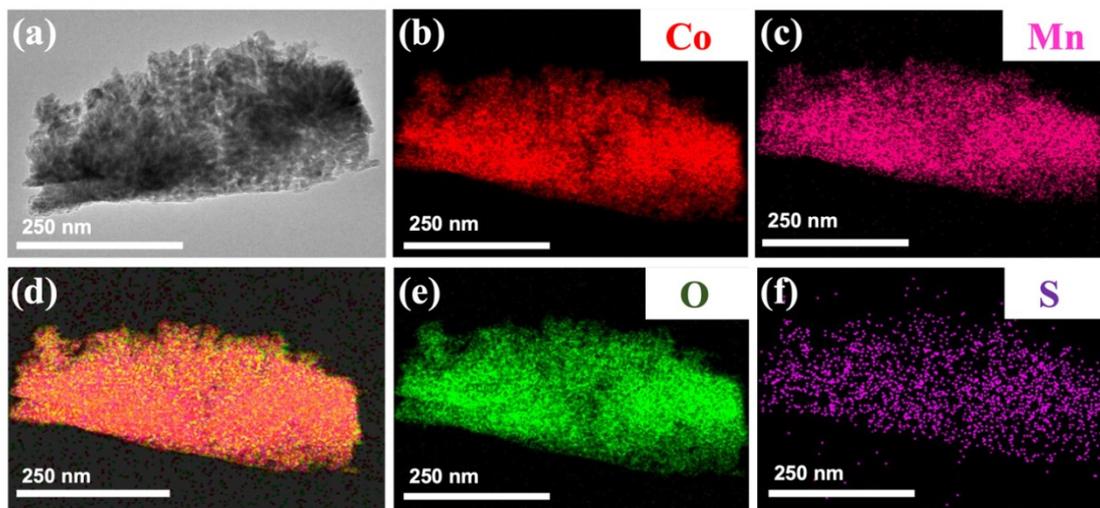


Figure S4 (a) FETEM images of p20-MCO@MS-5; (b, c, e, f) FESEM-EDS elemental mapping of Mn, Co, O, and S in p20-MCO@MS-5; (d) FETEM-EDS images of p20-MCO@MS-5.

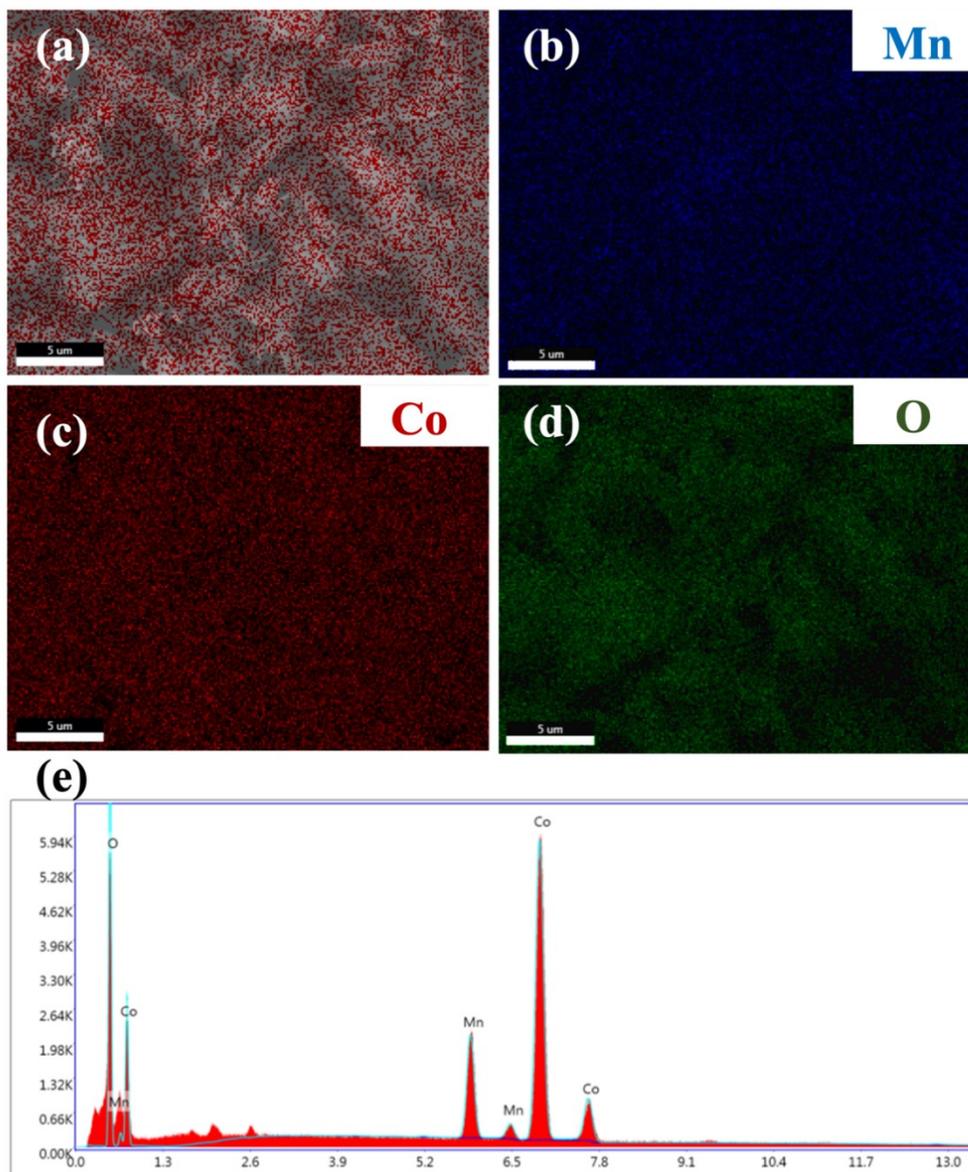


Figure S5 (a) FESEM images of MnCo₂O₄; (b-d) FESEM-EDS elemental mapping of Mn, Co, O in MnCo₂O₄; (e) The atomic composition characterization of MnCo₂O₄.

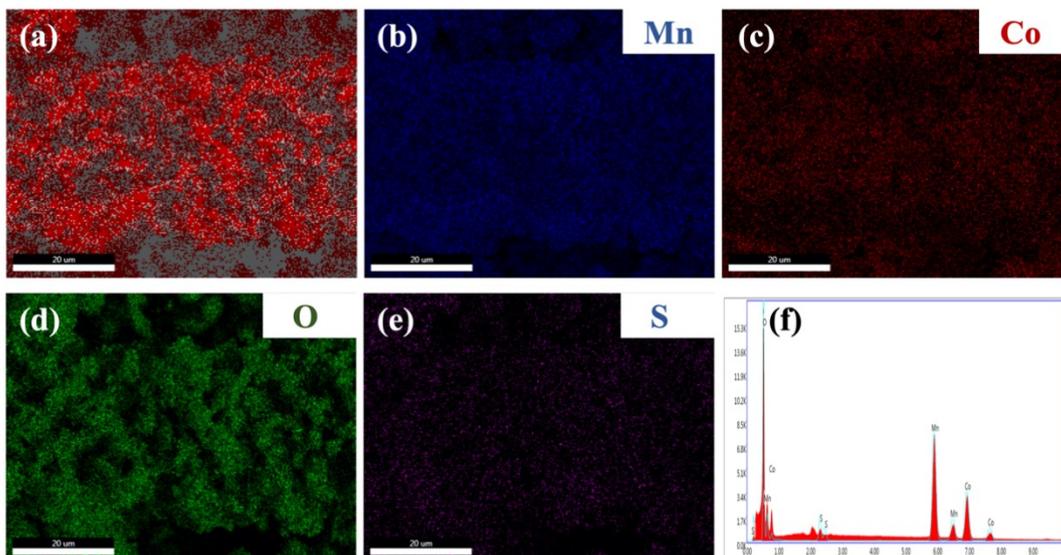


Figure S6 (a) FESEM images of MCO@MS-5; (b-e) FESEM-EDS elemental mapping of Mn, Co, O, and S in p20-MCO@MS-5;(f) The atomic composition characterization of MCO@MS-5.

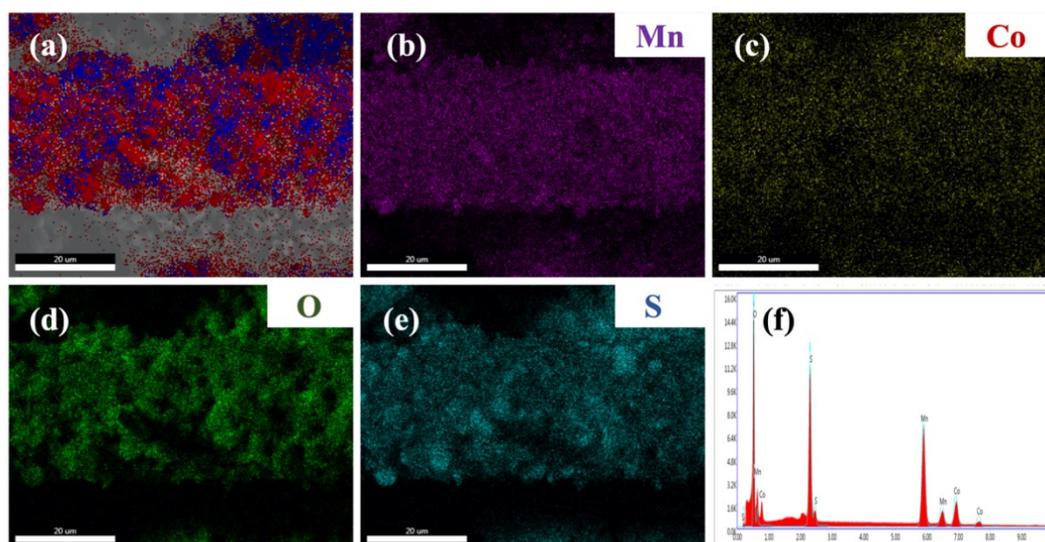


Figure S7 (a) FESEM images of p20-MCO@MS-5; (b-e) FESEM-EDS elemental mapping of Mn, Co, O, and S in p20-MCO@MS-5;(f) The atomic composition characterization of p20-MCO@MS-5.

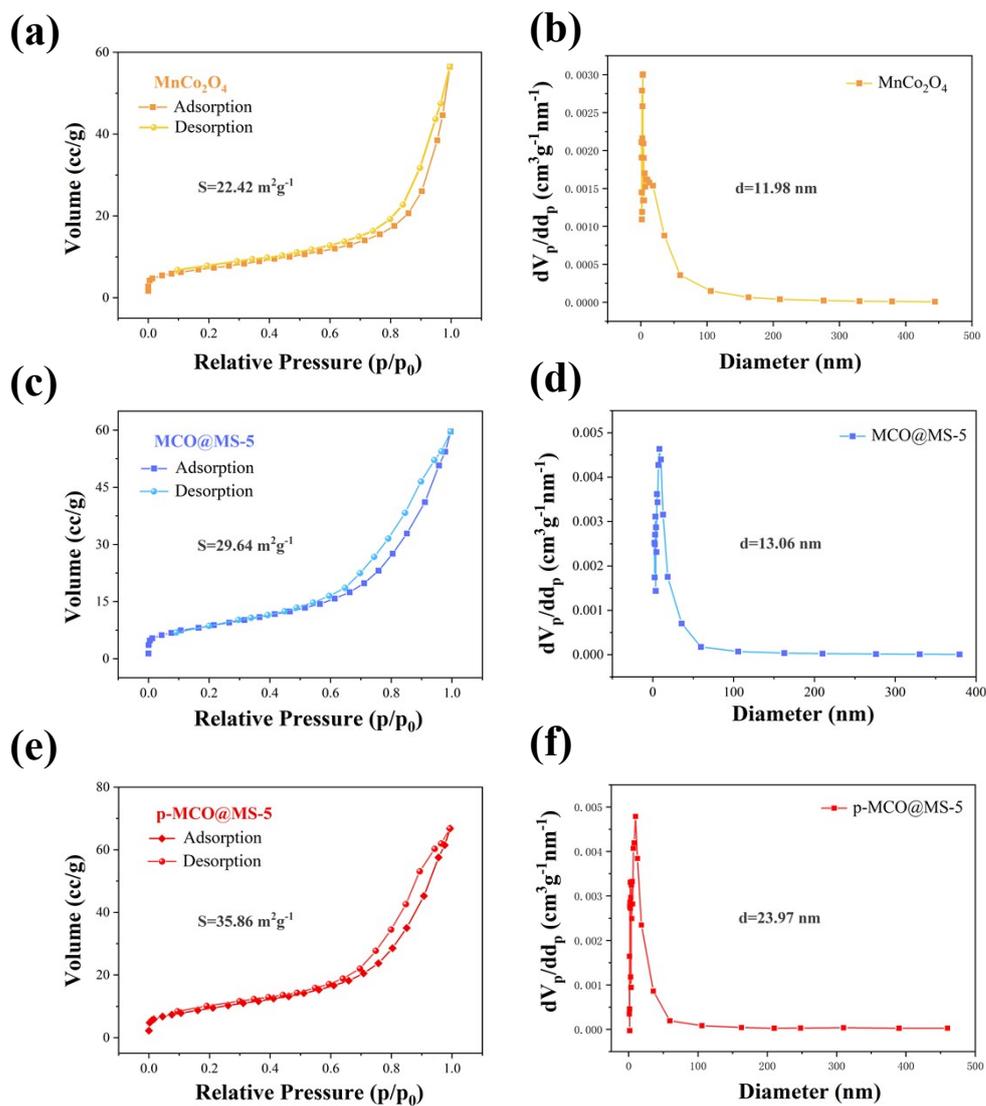


Figure S8 Nitrogen adsorption-desorption isotherms and pore size distribution curves of different samples.

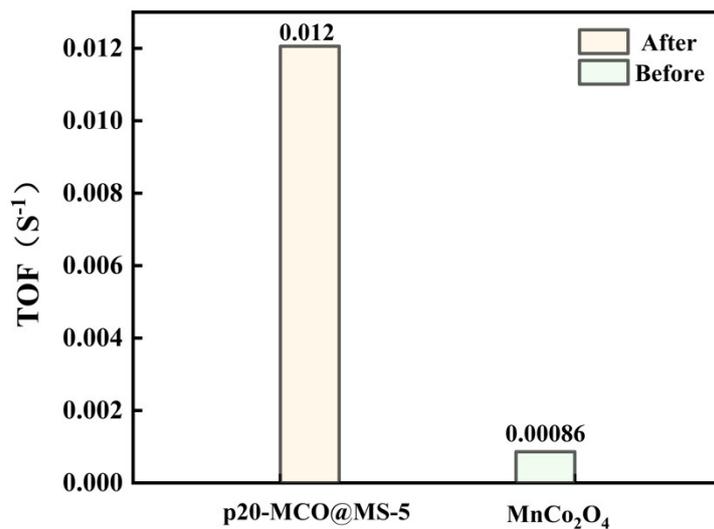


Figure S9 lower-limit TOF at 300 mV of p20-MCO@MS-5 and MnCo₂O₄.

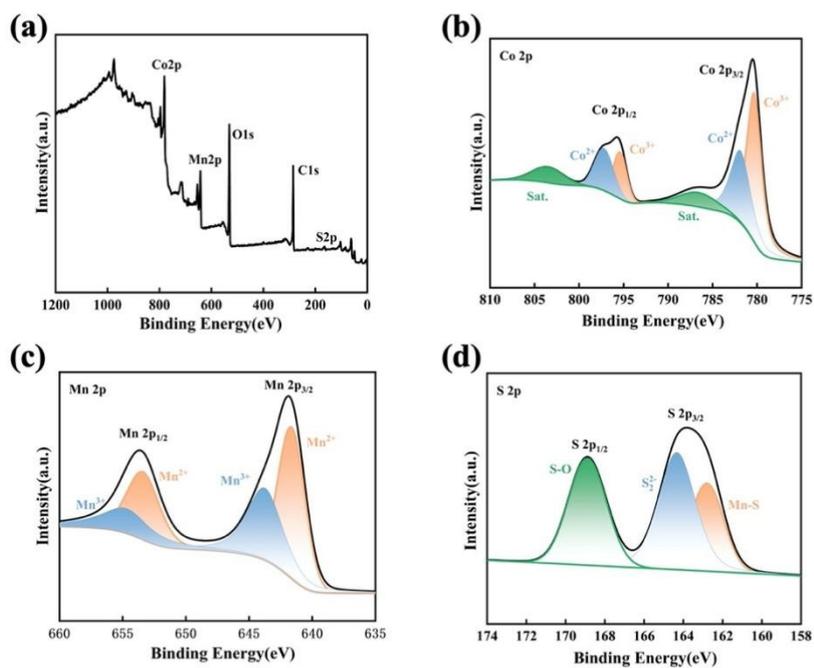


Figure S10 XPS of p20-MCO@MS-5 post-OER stability test.

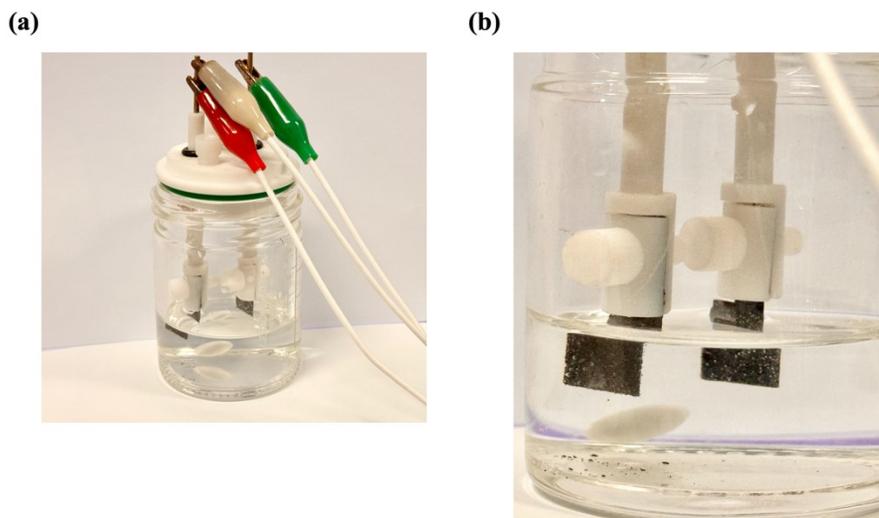


Figure S11 Photograph of the p20-MCO@MS-5 and commercial Pt/C (20%) two-electrode water splitting system in operation.

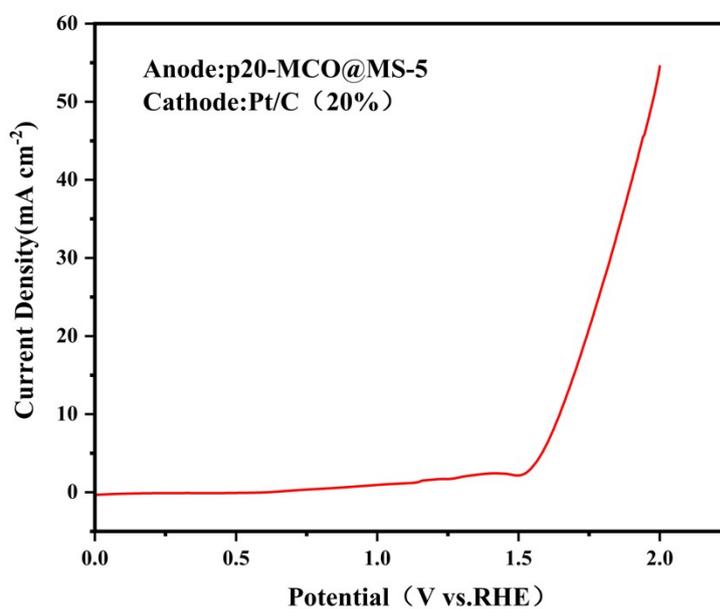


Figure S12 The LSV curve of the p20-MCO@MS-5 and commercial Pt/C (20%) two-electrode water splitting system.

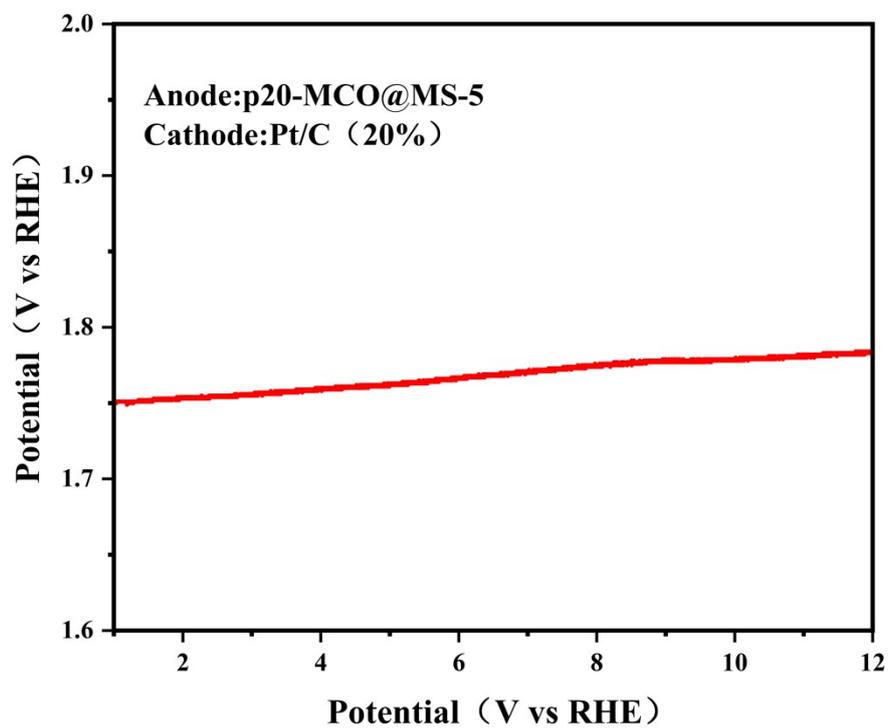


Figure S13 The chronopotentiometric stability test curve of the p20-MCO@MS-5 and commercial Pt/C (20%) two-electrode water splitting system at a current density of 10 mA cm⁻².